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**The Effects of Oil Prices Changes on Output Growth and Inflation: Evidence from Turkey**

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**Abstract:** This paper investigates the effects of oil price changes on output and inflation for the case of Turkey using monthly time series data for the period 1990:1–2012:3. Recent studies suggest that oil price changes may have asymmetric effects on the macroeconomic variables. To account for asymmetric effects, we decompose oil price changes into positive and negative parts following Hamilton (1996). Our results show that while oil price increases have clear negative effects on output growth, the impact of oil price decline is insignificant. Similarly, oil price increases have positive and significant effects on inflation. However, oil price declines have not a significant effect on inflation. The Granger causality tests also support these results.

**Keywords:** *Oil Price Changes; Inflation; Output Gap; Asymmetry; Granger-causality*

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**1. Introduction**

Oil price shocks may have an impact on macroeconomic variables through various transmission channels. First, rising oil prices leads higher energy costs and lowers usage of oil. Consequently, lower productivity of capital and labour hinders output growth (see Brown & Yücel, 1999; Abel & Bernanke, 2001). This is known as a classical supply-side effect. Second, higher oil prices have an income effect. An increase in oil prices leads to an income transfer from oil-importing countries to oil-exporting countries and thus reduces disposable income of oil consumers (see Dohner, 1981). Third one is real balance effect (see Mork, 1994). Oil-price-induced-inflation reduces real balances and money demand increases. If monetary authorities do not increase money supply to meet this growing money demand, interest rates rises and produce recessions. Fourth, oil price uncertainty might reduce investment expenditures (see Hamilton 1988, Bernanke 1983). It is argued that increasing uncertainty may also cause to recessions during oil crisis periods (see Pindyck & Rotemberg, 1983). Firms chose to postpone investment expenditures when they face increased uncertainty about future oil prices. Fifth, an oil price shock can affect unemployment through a change in the production structure. When oil prices increases, firms try to adopt production methods that are less oil-intensive. This change leads to a labour reallocations among sectors and can affect unemployment in the long-run (see Loungani, 1986). Sixth, oil price shocks have a pass-through effect into inflation (see Fuhrer, 1995; Hooker, 2002). The inflationary impact can be accompanied by second round effects, through price-wage loop.

Researches on the macroeconomic implications of oil price shocks have risen since the oil crisis of 1970s. In an influential article, Hamilton (1983) found a strong negative relationship between oil price changes and real economic activity in the U.S. data. Other researchers also supported results of Hamilton (1983) (see, for example, Darby, 1982; Gisser & Goodwin, 1986; Burbidge & Harrison, 1984; Bruno & Sachs, 1985). However, by the 1980s, it was observed that the declines in oil prices have a smaller positive effect on economic activity than estimated by linear models. The seeming breakdown in this interaction led the researchers to focus on the asymmetric relationship between oil price changes and economic activity. While oil price increases have a significant negative impact, oil price decreases may not have a positive effect on macroeconomic variables. Hamilton (1988) explained this asymmetry theoretically by introducing adjustment costs. Some researchers investigated such asymmetry empirically. For example, Mork (1989) established the existence of asymmetric responses of GNP growth in the U.S. to oil price increases and decreases. Mork et al. (1994) find that most OECD countries experienced this asymmetric relationship between oil price and GDP growth. Lee et al. (1995) argue that the highly volatile oil price movements led to a breakdown the relationship between oil price shocks and U.S. economic activity.

Some studies tried to explain the asymmetric reaction of economic activity to oil price shocks. It is argued that monetary policy may give rise to asymmetry. While monetary authorities may implement a restrictive monetary policy in response to oil price increases, it may not pursue expansionary policies in the case of oil price declines (see Bohi, 1991; Bernanke et al., 1997; Barsky & Kilian, 2001). On the other hand, the analysis of Hamilton & Herrera (2004) and Balke et al. (2002) showed that monetary policy's response is not the sole cause of asymmetry. Lilien (1982) and Hamilton (1988) explained the asymmetric response by the cost of changing oil prices. Sectoral imbalances and coordination problems between firms can also induce adjustment costs. Finally, it is argued that increased uncertainty generated by oil price shocks can lead to asymmetry. Ferderer (1996) argued that the increased volatility generated by increases in oil prices reinforces the negative effects, while volatility generated by decreased oil prices offsets the positive effects.

The relationship between oil prices and inflation is also discussed in the literature. Trehan (2005) observed that while rising oil prices were accompanied by inflation during 1970s, this relationship have deteriorated over the latter part of the sample. Hooker (2002) found a significant impact of oil prices on inflation for the period 1962-1980, but not for the period from 1981 to 2000. As suggested by Trehan (2005), changing inflation expectations are likely to provide a part of explanation to change in the relationship between oil prices and inflation. Declining inflation and inflation volatility has been accompanied by a decline in inflation expectations since the 1970s. While it was expected that the Fed did not act to offset inflationary effect of higher oil prices during 1970s, more recently, it is expected that the Fed act to withstand this inflationary effect. Thus, inflationary impact of oil shocks has declined. Chen (2009) examined 19 industrial countries and supported this evidence. Cunado & Perez de Garcia (2005) showed that oil prices have significant effects on both economic activity and inflation for six Asian economies. Jacquinet et al. (2009) found that oil price shocks have an important impact on inflation in the short-run in the euro-area.

The aim of this paper is to explore the effects of oil price shocks on output and inflation in the case of Turkey. Expected industrial development potential in Turkey represents a significant growth prospective and oil is a critical factor for Turkey's economic growth. Manufacturing, transportation and electricity generation mainly depends on oil. Since oil is an important input to these sectors, it is probably that oil price shocks have a potential to affect the production level in Turkey. Furthermore, Turkey's domestic oil production meets very limited portion of its requirements. Therefore oil is one of the most important import items for Turkey. 90 percent of Turkey's crude oil is imported. 70 percent of domestically produced oil is obtained from state-run Turkish Petroleum Corporation (TPAO). The remainder is produced mainly by Royal Dutch/Shell. The oil dependent structure of Turkey makes oil prices a significant variable for Turkey's economy. Also Turkey has a strategic importance since it is becoming an important oil transit country from Russia, the Caspian Sea and the Middle East to Europe. The studies on the oil price-macro economy relationship are mostly on advanced economies. There are only a few studies for Turkey. For example, Kapoor (2011) investigates how economic activity in emerging markets may be affected by oil price shocks. He find that the relationship between net oil price increases and real GDP growth are statistically significant for Turkey for the period of 2000: I-2009:IV. Alper & Torul (2008) use a structural VAR model to analyze the response of output growth to oil price increases for Turkey. They find that the negative impact of oil price changes on aggregate economic activity is significant in the case of the potential effects of global liquidity conditions are included in the model.

There are limited numbers of researches which investigate the inflationary effects of oil prices for Turkey. Kibritcioglu & Kibritcioglu (1999) do not find a statistically significant relationship between oil prices and general price level. They assume that factor prices are fixed in nominal values. Berument & Taşçı (2002) show that the inflationary effect of increasing prices of oil is significant in the case of factors of income is adjusted to inflation that includes the oil price increases. Çatık & Önder (2011) investigate the inflationary impacts of oil prices by employing Markov regime-switching models. They compare the oil pass-through under the high and low inflationary periods and find evidence for asymmetric oil pass-through in the high-inflation regime. We considered the possibility of asymmetric responses to oil price increases and decreases, as suggested in the literature. Therefore we assessed the model following Hamilton (1988) to analyze the relationship between oil price shocks and macro variables for Turkey. Our results confirm a negative effect of oil price increases on economic activity and a positive effect on inflation. On the other hand, we do not find any significant effects of oil price declines. Also we found that positive oil price shocks Granger-cause the

macroeconomic variables, but that negative shocks do not. The remainder of this paper is organized as follows. Section 2 describes the empirical framework to be used in the analysis. Section 3 details the data and empirical results. In section 4 we discuss economic implications of our results.

## 2. Methodology

We consider the following regression equations for inflation and output, respectively:

$$\pi_t = \alpha_{\pi 0} + \sum_{i=1}^l \beta_{\pi i} \pi_{t-i} + \sum_{i=1}^m \gamma_{\pi i} y_{t-i} + \sum_{i=1}^n \theta_{\pi i} r_{t-i} + \sum_{i=1}^o \partial_{\pi i} oil_{t-i} + \varepsilon_{\pi t} \quad (1)$$

$$y_t = \alpha_{y 0} + \sum_{i=1}^p \beta_{y i} y_{t-i} + \sum_{i=1}^q \gamma_{y i} \pi_{t-i} + \sum_{i=1}^s \theta_{y i} r_{t-i} + \sum_{i=1}^t \partial_{y i} oil_{t-i} + \varepsilon_{y t} \quad (2)$$

Where  $\pi_t$  is the inflation rate,  $y_t$  is the output,  $r_t$  is the interest rate and  $oil_t$  is the real oil price change,  $\varepsilon_t$  is the disturbance term.

Equations (1) and (2) do not allow for analyzing the effects of positive and negative oil price shocks. Therefore, in order to account for effects of positive and negative oil price shocks, we decompose oil price changes into positive and negative changes, and amend the system of equations as follows:

$$\pi_t = \alpha_{\pi 0} + \sum_{i=1}^l \beta_{\pi i} \pi_{t-i} + \sum_{i=1}^m \gamma_{\pi i} y_{t-i} + \sum_{i=1}^n \theta_{\pi i} r_{t-i} + \sum_{i=1}^o \partial_{\pi i}^- oil_{t-i}^- + \sum_{i=1}^o \partial_{\pi i}^+ oil_{t-i}^+ + \varepsilon_{\pi t} \quad (3)$$

$$y_t = \alpha_{y 0} + \sum_{i=1}^p \beta_{y i} y_{t-i} + \sum_{i=1}^q \gamma_{y i} \pi_{t-i} + \sum_{i=1}^s \theta_{y i} r_{t-i} + \sum_{i=1}^t \partial_{y i}^- oil_{t-i}^- + \sum_{i=1}^t \partial_{y i}^+ oil_{t-i}^+ + \varepsilon_{y t} \quad (4)$$

Where  $oil_t^-$  represents the negative changes in the oil price and  $oil_t^+$  represents positive changes, and are defined as  $oil_t^- = \min(oil_t, 0)$  and  $oil_t^+ = \max(oil_t, 0)$ .

In principle, the system of equations given in eq. (1) and (2) (or in (3) and (4)) can be estimated using ordinary list squares (OLS) estimator. However, this approach does not take account of mutual dependence between the equations, and hence may not produce efficient estimates. Therefore, we apply a system approach and estimate the equations simultaneously. The model specification and estimation procedure is as follows. First, we define each equation in the system with a maximum lag order of 12 and estimate each equation separately by OLS estimator. Then we delete the intermediate lags one by one (starting with the least statistically insignificant one according to the t-statistics), provided that such deletion increases Akaike Information Criterion. Once the optimal lag order of each covariate is determined, we estimate the system of equations using Generalized Least Squares (GLS) estimator iteratively. Employing GLS iteratively gives Maximum Likelihood (ML) estimates and brings efficiency gains over OLS estimates (Greene, 1997; 681-682). Initial guess of the variance-covariance matrix of the error terms are defined as follows:

$$\hat{\Sigma} = \begin{bmatrix} \hat{\sigma}_{\varepsilon \pi t}^2 & 0 \\ 0 & \hat{\sigma}_{\varepsilon y t}^2 \end{bmatrix}$$

Where  $\hat{\sigma}_{\varepsilon \pi t}^2$  and  $\hat{\sigma}_{\varepsilon y t}^2$  are estimated variance of error terms from inflation and output equations, respectively. The system of equations consisting equations (3) and (4) are estimated in the same way. After estimating each system, we test whether oil price changes affect output and inflation. Specifically, in order to test whether oil price changes affect output and inflation, we test the null hypotheses  $H_0 : \sum \partial_{y i} = 0$  and  $H_0 : \sum \partial_{\pi i} = 0$ , respectively, in the system consisting equations (1) and (2). In order to test whether oil price Granger-causes output and inflation, we test the hypotheses  $H_0 : \partial_{y i} = 0$  and  $H_0 : \partial_{\pi i} = 0$ , for all  $i$ , respectively. Similarly, after estimating the system of equations (3) and (4) we test whether negative and

positive oil price changes affect output and inflation by testing the null hypotheses  $H_0 : \sum \partial_{yi}^- = 0$ ,  $H_0 : \sum \partial_{yi}^+ = 0$ ,  $H_0 : \sum \partial_{\pi i}^- = 0$ , and  $H_0 : \sum \partial_{\pi i}^+ = 0$ , respectively. Whether negative and positive oil price changes Granger-cause output and inflation are tested by testing the null hypotheses  $H_0 : \partial_{yi}^- = 0$ ,  $H_0 : \partial_{yi}^+ = 0$ ,  $H_0 : \partial_{\pi i}^- = 0$ ,  $H_0 : \partial_{\pi i}^+ = 0$  and  $H_0 : \sum \partial_{\pi i} = 0$ , respectively.

### 3. Data and Empirical Results

In this study we use monthly data for the period 1990:1-2012:3. Real oil price ( $oil_t$ ) is obtained by multiplying the nominal oil price expressed in U.S. Dollars by the nominal exchange rate and deflating it by using consumer price index (CPI). Output gap ( $gap_t$ ) is proxied by (logarithm of) the industrial production index detrended by Hodrick-Prescott (HP) filter. Inflation ( $\pi_t$ ) is measured as logarithmic first difference in CPI. In the empirical application, we used logarithmic first differences of real oil price ( $oil_t$ ) and logarithm of annualized interest rate, ( $r_t$ ). The data are taken from International Financial Statistics databases (IFS) except for the interest rate, which is taken from electronic data dissemination system of the Central Bank of the Republic of Turkey (CBRT). Before estimating the system of equations, we test stationarity of the data using Augmented Dickey-Fuller (ADF) test. The results of the ADF test are given in Table 1. As the results of the ADF test suggest, all variables are stationary.

**Table 1: Results of the ADF Unit Root Test**

Variable	Constant	Constant and Trend	None
Inflation Rate	-1.011	-10.070*	-1.172
Output Gap	-5.894*	-5.883*	-5.906*
Real interest rate	-2.843***	-5.233*	-1.695***
Change in oil prices	-13.756*	-13.758*	-13.770*

Notes: \*, and \*\*\* denote rejection of the null hypothesis of unit root at 1%, and 10% significance levels.

Since all variables are found to be stationary, we proceed to estimate both systems of equations, mainly the system consisting equations (1) and (2), and the system consisting equations (3) and (4). As briefly discussed above, the system of equations (1) and (2) assume that oil price changes affect both inflation and output symmetrically. On the other hand, the system of equations (3) and (4) assume that oil price increases and declines affect both inflation and output asymmetrically. The results of estimates for the inflation equations (i.e., estimates of equations 1 and 3) are reported in Table 2. The estimates of parameters of the output equation (i.e., estimates of equations 2 and 4) are reported in Table 3.

**Table 2: Estimation Results of Inflation Equations**

	Equation 1		Equation 3	
	Coefficient	Standard error	Coefficient	Standard error
Constant	-0.000	(0.000)	-0.001	(0.000)
$\pi_{t-1}$	0.350*	(0.058)	0.359*	(0.058)
$\pi_{t-2}$	-0.104***	(0.059)	-0.098***	(0.059)
$\pi_{t-7}$	0.095***	(0.053)	0.102***	(0.053)
$\pi_{t-8}$	-0.127**	(0.057)	-0.126**	(0.057)
$\pi_{t-9}$	0.171*	(0.057)	0.174*	(0.057)
$\pi_{t-10}$	-0.099***	(0.059)	-0.092	(0.059)
$\pi_{t-11}$	0.190*	(0.059)	0.192*	(0.059)

$\pi_{t-12}$	0.204*	(0.055)	0.211*	(0.055)
$r_{t-1}$	0.059*	(0.008)	0.058*	(0.008)
$r_{t-2}$	0.014***	(0.008)	0.015***	(0.008)
$r_{t-3}$	-0.047*	(0.009)	-0.052*	(0.010)
$r_{t-5}$	0.022*	(0.007)	0.023*	(0.007)
$r_{t-12}$	-0.021*	(0.007)	-0.021*	(0.007)
$oil_{t-3}$	0.019***	(0.010)	-	-
$oil_{t-3}^+$	-	-	0.043**	(0.020)
$oil_{t-3}^-$	-	-	-0.002	(0.018)

Notes: \*, \*\*, and \*\*\* denotes significance of the coefficient at the 1%, 5%, and 10% level.

As can readily be seen from Table 2, the effect of oil price changes on inflation is positive and statistically significant only at 10% significance level. On the other hand, when oil price changes are decomposed into positive and negative changes, it is found that only positive change in oil prices affects inflation rate. In fact, the coefficient of positive oil price change ( $oil^+$ ) is positive and statistically significant at 5% significance level whereas the coefficient of negative oil price change ( $oil^-$ ) is negative but statistically insignificant.

**Table 3: Estimation Results of Output Equations**

	Equation 2		Equation 4	
	Coefficient	Standard error	Coefficient	Standard error
Constant	0.001	(0.002)	0.005	(0.003)
$gap_{t-1}$	0.223*	(0.049)	0.211*	(0.051)
$gap_{t-2}$	0.426*	(0.053)	0.394*	(0.053)
$gap_{t-5}$	0.152*	(0.052)	0.151*	(0.054)
$gap_{t-10}$	-0.152*	(0.056)	-0.160*	(0.058)
$gap_{t-12}$	0.202*	(0.053)	0.210*	(0.054)
$gap_{t-13}$	-0.287*	(0.048)	-0.281*	(0.050)
$\pi_{t-2}$	0.229***	(0.127)	0.206	(0.130)
$\pi_{t-4}$	0.242***	(0.124)	0.238***	(0.127)
$r_{t-1}$	-0.059*	(0.018)	-0.057*	(0.018)
$r_{t-2}$	-0.052*	(0.019)	-0.047**	(0.020)
$r_{t-6}$	0.035**	(0.016)	0.031**	(0.016)
$r_{t-11}$	0.033**	(0.015)	0.029**	(0.015)
$oil_t$	0.090*	(0.025)		
$oil_{t-2}$	0.042***	(0.025)		
$oil_{t-5}$	-0.053**	(0.024)		
$oil_{t-10}$	-0.040***	(0.024)		
$oil_t^+$			0.083***	(0.047)
$oil_{t-2}^+$			0.004	(0.050)
$oil_{t-5}^+$			-0.095**	(0.048)
$oil_{t-10}^+$			-0.072***	(0.042)
$oil_t^-$			0.099**	(0.045)

$oil_{t-2}^-$	0.066	(0.046)
$oil_{t-5}^-$	-0.010	(0.045)
$oil_{t-10}^-$	-0.002	(0.045)
$\sum oil = 0$	5.153 [0.000]	
$\sum oil^+ = 0$	2.529 [0.041]	
$\sum oil^- = 0$	1.704 [0.150]	

Notes: \*, \*\*, and \*\*\* denotes significance of the coefficient at the 1%, 5%, and 10% level. p-values of the test statistics are reported in brackets.

The parameter estimates of the output equations are reported in Table 3. In order to test whether a change in oil prices affect output or not, we test the null hypothesis that the sum of the coefficients of the lagged oil price changes is equal to zero. The results of the hypothesis tests are reported in the bottom of the table. As the results of the hypothesis tests suggest, the effects of oil price changes is statistically different from zero. When oil price changes is decomposed into negative and positive parts, we find that the sum of the parameters of oil price increases ( $oil^+$ ) is negative and statistically significant at 5% significance level whereas the sum of the parameters of oil price decreases is statistically insignificant, suggesting that oil price decreases do not affect output.

**Table 4: Granger causality test**

Null hypothesis $H_0$	$\chi^2$ -statistic	$p$ -value
$oil$ does not Granger cause $gap$	21.748	0.000
$oil$ does not Granger cause $\pi$	3.328	0.068
$oil^+$ does not Granger cause $gap$	11.044	0.026
$oil^-$ does not Granger cause $gap$	7.440	0.114
$oil^+$ does not Granger cause $\pi$	4.393	0.036
$oil^-$ does not Granger cause $\pi$	0.012	0.912

In addition, we also conducted Granger-causality tests, results of which are presented in Table 4. The results suggest that fluctuations in oil prices affect both output and inflation in Turkey, although the evidence for the Granger-causal effects running from oil prices to inflation is statistically weak. When we decompose oil price changes into positive and negative parts, we find that oil price increases affect both inflation and output gap whereas oil price declines affect neither inflation nor output gap. This finding once more suggests that the effects of oil price changes stem mainly from negative effects of oil price increases on macroeconomic variables.

The Turkish economy underwent a serious financial and economic crisis in February, 2001. Overnight interest rates rose to above 4000%, the Turkish Lira depreciated by 40% in a day against USD. As a result, the economy declined by 5.7% in that year. Just after the crisis, Turkey abandoned exchange rate based stabilization program. The crawling-peg exchange rate system was replaced by floating exchange rate system and more stringent fiscal policy was adopted. After the crisis, the Central Bank of Turkey was granted independence in conduct of monetary policy. The Central Bank pursued implicit inflation targeting policies until 2006 when switched to explicit inflation targeting. It can be expected that the economic crisis and switch in monetary policy may affect the oil price-output and oil price-inflation relationship. In order to test if there was any structural change as a result of the economic crisis, we implemented the Chow structural stability

test. The break point was taken as February 2001. The results of the Chow stability test are presented in Table 5.

**Table 5: Chow test results**

	<b>F-Statistic</b>
Inflation Equation	1.934*
Output Equation	1.758*

*Note: The asterisk indicates significance at the 5% significance level.*

The results of the Chow stability tests suggest that the null hypothesis of stability of the regression coefficient is strongly rejected for both equations. Therefore, we apply Granger causality tests for these sub-periods. The results are presented in Table 6.

**Table 6: Granger causality test for sub-periods**

	$\chi^2$ -statistic	<i>p</i> -value
<b>1990:01-2001:02</b>		
<i>oil</i> does not Granger cause <i>gap</i>	8.477	0.076
<i>oil</i> does not Granger cause $\pi$	3.664	0.056
<i>oil</i> <sup>+</sup> does not Granger cause <i>gap</i>	4.248	0.373
<i>oil</i> <sup>-</sup> does not Granger cause <i>gap</i>	1.247	0.870
<i>oil</i> <sup>+</sup> does not Granger cause $\pi$	4.263	0.039
<i>oil</i> <sup>-</sup> does not Granger cause $\pi$	0.000	0.991
<b>2001:03-2012:03</b>		
<i>oil</i> does not Granger cause <i>gap</i>	16.240	0.003
<i>oil</i> does not Granger cause $\pi$	0.002	0.968
<i>oil</i> <sup>+</sup> does not Granger cause <i>gap</i>	12.221	0.016
<i>oil</i> <sup>-</sup> does not Granger cause <i>gap</i>	6.337	0.175
<i>oil</i> <sup>+</sup> does not Granger cause $\pi$	0.088	0.767
<i>oil</i> <sup>-</sup> does not Granger cause $\pi$	0.051	0.821

Granger causality tests over the period 1990:01-2001:02 suggest that oil price Granger-causes output, although the evidence is statistically weak. We find that negative and positive oil price changes do not Granger-cause during this sub-period. For the 2001:03-2012:12 period, on the other hand, our results suggest that an increase in oil prices Granger-cause output while decreases have no statistically significant effects on output. Note that we reached to the same result for the entire period. As regards effects of oil price changes on inflation rate, we find that only an increase in oil price Granger-cause inflation whereas decreases in oil prices do not affect inflation rate during the period 1990:01-2001:02. For the 2001:03-2012:12 sub-period, however, we find that neither positive nor negative oil price changes Granger-cause inflation rate. Disappearance of causality from oil prices to inflation may be explained by inflation targeting policies implemented by the Central Bank of Republic of Turkey after the 2001 crisis as well as tax policies in place. In fact, in addition to tight rigorous monetary policies, Turkey pursued tight fiscal policies to fight high and

chronic inflation. As a result, annual inflation rate was reduced to one-digit levels in 2005. In addition, tax on fuel is being frequently adjusted so that domestic price of fuel products react to oil price changes with lag and not fully. Therefore, it is not surprising to find that the effects of oil price changes on domestic inflation rate diminished during the disinflation period.

#### 4. Conclusion

The majority of empirical works that investigate the relationship between oil prices and macroeconomic variables have applied various linear and nonlinear methodologies. While most of these studies considered advanced economies, increasing oil demand from emerging economies make the study of oil prices and developing countries highly pertinent. In this paper, we examine the relationships between the price of oil - real economic activity and price of oil - inflation for a developing country, Turkey. Oil prices are a significant variable for Turkey since oil is the main energy source for many sectors. In addition, demographic and economic growth potential of Turkey makes it a major oil market. Furthermore, oil is one of the most important import items for Turkey since domestic oil production is very limited. We first examine the effects of oil price on economic activity and inflation assuming that oil price increases and decreases affect economic variables symmetrically. Our results suggest that oil prices have statistically significant effect both on inflation and economic activity. However, it is well known that asymmetries exist in the links between oil price and inflation and oil price and economic activity. In order to account for effects of positive and negative oil price shocks we estimate an asymmetric model following Hamilton (1996). Our results show that an increase in oil prices has a positive and significant effect on inflation. However, a decline in oil prices does not have a significant impact on inflation. We also find that output declines due to an increase in oil prices. On the other hand, a decline in oil prices is insignificant to explain changes in output and overall effects of oil price decreases is not statistically different from zero. The Granger causality tests also show that while positive rate of change in the oil prices affects both output and inflation, a decline in oil prices does not. These results provide evidence against the linear approach that assumes that oil prices have symmetric effects on the macroeconomic variables.

Such an asymmetry may be explained by market imperfections and tax policies in place. As shown by Alper & Torul (2009), domestic oil prices in Turkey respond only to increases in oil prices. In addition, since government imposes high taxes on gasoline in Turkey, taxes are one of the biggest contributors to gasoline prices. Due to high taxes, declines in the world oil prices are not reflected in domestic prices. In addition to asymmetric price transmission from world oil prices to domestic prices, market imperfections in other markets also contribute to such asymmetries. If prices are not flexible downwards, a reduction in input costs will not lead to a reduction in prices, and hence changes in prices of intermediate costs will affect economy asymmetrically. Finally, we examined stability of the effects of oil-price changes on inflation and output. In particular, we applied Chow stability test and find a strong evidence of structural change aftermath the economic crisis in 2001. Therefore, we split the data in two sub-periods, before and after the crisis, and apply Granger-causality tests for each sub-period. Results of the Granger-causality tests suggest that changes in oil prices do not Granger-cause output before the crisis but increases in oil prices affect output after the crisis. On the other hand, oil price changes affect inflation rate only before the crisis. The changes in oil prices do not Granger cause inflation during the disinflation period after the crisis.

#### References

- Abel, A. B. & Bernanke, B. S. (2001). *Macroeconomics*, Addison Wesley Longman Inc.
- Alper, C. E. & Torul, O. (2008). Oil Prices, Aggregate Economic Activity and Global Liquidity Conditions: Evidence from Turkey. *Economics Bulletin*, 23, 17, 1-8.
- Alper, C. E. & Torul, O. (2009). Asymmetric Adjustment of Retail Gasoline Prices in Turkey to World Crude Oil Price Changes: The Role of Taxes. *Economics Bulletin*, 29(2), 775-787.
- Balke, N., Brown, S. P. A. & Yucel, M. K. (2002). Oil Price Shocks and the U.S. Economy: Where Does the Asymmetry Originate? *Energy Journal*, 23(3), 27-51.



- Barsky, R. B. & Kilian, L. (2001). Do We Really Know That Oil Caused the Great Stagflation: a Monetary Alternative (with comments). National Bureau of Economic Research. Working Paper 8289.
- Bernanke, B. S. (1983). Irreversibility, Uncertainty, and Cyclical Investment. *The Quarterly Journal of Economics*, 98(1), 85-106.
- Bernanke, B. S., Gertler, M. & Watson, M. (1997). Systematic Monetary Policy and the Effects of Oil Price Shocks. *Brookings Papers on Economic Activity, Economic Studies Program. The Brookings Institution*, 28(1), 91-157
- Berument, H. & Taşçı, H. (2002). Inflationary Effect of Crude Oil Prices in Turkey. *Physica A: Statistical Mechanics and its Applications*, 316(1-4), 568-580.
- Bohi, D. R. (1991). On the Macroeconomic Effects of Energy Price Shocks. *Resources and Energy*, 13(2), 145-162.
- Brown, S. P. A. & Yücel, M. K. (1999). Oil Prices and U.S. Aggregate Economic Activity: A Question of Neutrality. *Economic and Financial Policy Review, Federal Reserve Bank of Dallas*, 2<sup>nd</sup> Quarter, 13-21.
- Bruno, M. R. & Sachs, J. (1985). *Economics of worldwide stagflation*. Cambridge, MA: Harvard University Press.
- Burbidge, J. & Harrison, A. (1984). Testing for the Effects of Oil-Price Rise Using Vector Autoregressions. *International Economic Review*, 25(2), 459-484.
- Chen, S. (2009). Oil Price Pass-Through into Inflation. *Energy Economics*, 31(1), 126-133.
- Cunado, J. & Perez de Gracia, F. (2005). Oil Prices, Economic Activity and Inflation: Evidence for Some Asian Countries. *Quarterly Review of Economics and Finance*, 45(1), 65-83.
- Çatık, A. N. & Önder, A. Ö. (2011). Inflationary Effects of Oil Prices in Turkey: A Regime-Switching Approach. *Emerging Markets Finance and Trade*, 47(5), 125-140.
- Darby, R. M. (1982). The Price of Oil and World Inflation and Recession. *American Economic Review*, 72(4), 738-751.
- Dohner, R. S. (1981). Energy Prices, Economic Activity and Inflation: Survey of Issues and Results. In: *Energy Prices, Inflation and Economic Activity*, ed. Mork, K.A., Cambridge Mass., Ballinger.
- Ferderer, J. P. (1996). Oil Price Volatility and the Macroeconomy: A Solution to the Asymmetry Puzzle. *Journal of Macroeconomics*, 18, 1-16.
- Fuhrer, J. C. (1995). The Phillips Curve is Alive and Well. *New England Economic Review of the Federal Reserve Bank of Boston*, (March/April), 41-56.
- Gisser, M. & Goodwin, T. H. (1986). Crude Oil and the Macroeconomy: Tests of Some Popular Notions: Note. *Journal of Money, Credit and Banking*, 18(1), 95-103.
- Greene, W. H. (1997). *Econometric Analysis*, Third Edition. Prentice Hall, New Jersey, USA.
- Hamilton, J. (1983). Oil and the Macroeconomy Since World War II. *Journal of Political Economy*, 91(2), 228-248.
- Hamilton, J. (1988). A neoclassical Model of Unemployment and the Business Cycle. *Journal of Political Economy*, 96(3), 593-617.
- Hamilton, J. (1996). This is What Happened to the Oil Price-Macroeconomy Relationship. *Journal of Monetary Economics*, 38(2), 215-220.
- Hamilton, J. & Herrera, A. M. (2004). Oil Shocks and Aggregate Macro-Economic Behavior: The Role of Monetary Policy: A comment. *Journal of Money, Credit and Banking*, 36(2), 265-286.
- Hooker, M. A. (2002). Are Oil Shocks Inflationary? Asymmetric and Nonlinear Specifications Versus Changes in Regime. *Journal of Money, Credit and Banking*, 34(2), 540-561.
- Jacquinot, P., Kuismanen, M., Mestre, R. & Spitzer, M. (2009). An Assessment of the Inflationary Impact of oil Shocks in the Euro Area. *The Energy Journal*, 30(1), 49-84.
- Kapoor, A. (2011). The economic impact of oil price shocks on emerging markets, CMC Senior Thesis, Claremont McKenna College, California, USA.
- Kibritçiöğlu, A. & Kibritçiöğlu, B. (1999). Ham petrol ve Akaryakıt Ürünü Fiyat Artışlarının Türkiye'deki Enflasyonist Etkileri. (The Inflationary Effects of Increases in Crude Oil and Fuels' Prices in Turkey). Turkish Republic Undersecretariat of Treasury, Working Paper Series, No. 21.
- Lee, K., Ni, S. & Ratti, R. A. (1995). Oil Shocks and the Macroeconomy: The Role of Price Variability. *The Energy Journal*, 16(4), 39-56.
- Lilien, D. (1982). Sectoral Shifts and Cyclical Unemployment. *Journal of Political Economy*, 90(4), 777-793.

- Loungani, P. (1986). Oil Price Shocks and the Dispersion Hypothesis. *Review of Economics and Statistics*, 68(3), 536–539.
- Mork, K. A. (1989). Oil and the Macroeconomy When Prices Go Up and Down: An Extension of Hamilton's Results. *Journal of Political Economy*, 97(3), 740–744.
- Mork, K. A. (1994). Business Cycles and the Oil Market. *The Energy Journal*, 15, 15–38.
- Mork, K. A., Olsen, O. & Mysen, T. H. (1994). Macroeconomic Responses to Oil Price Increases and Decreases in Seven OECD Countries. *The Energy Journal*, 15(4), 19–35.
- Pindyck, R. S. & Rotemberg, J. J. (1983). Dynamic Factor Demands and the Effects of Energy Price Shocks. *American Economic Review*, 73(5), 1066–1079.
- Trehan, B. (2005). Oil Price Shocks and Inflation. *FRBSF Economic Letter*, 28, 1-3.